Marco Fulle - www.stromboli.net

New Quantitative Volcanic Cloud and Fog Products for GOES-R

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(UW-CIMSS)

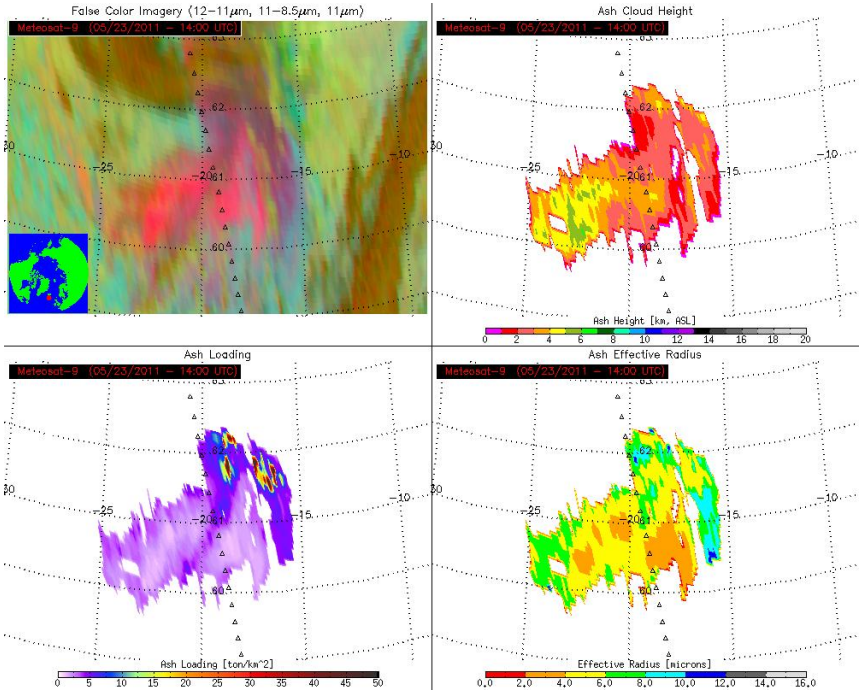
GOES-R Volcanic Cloud Products

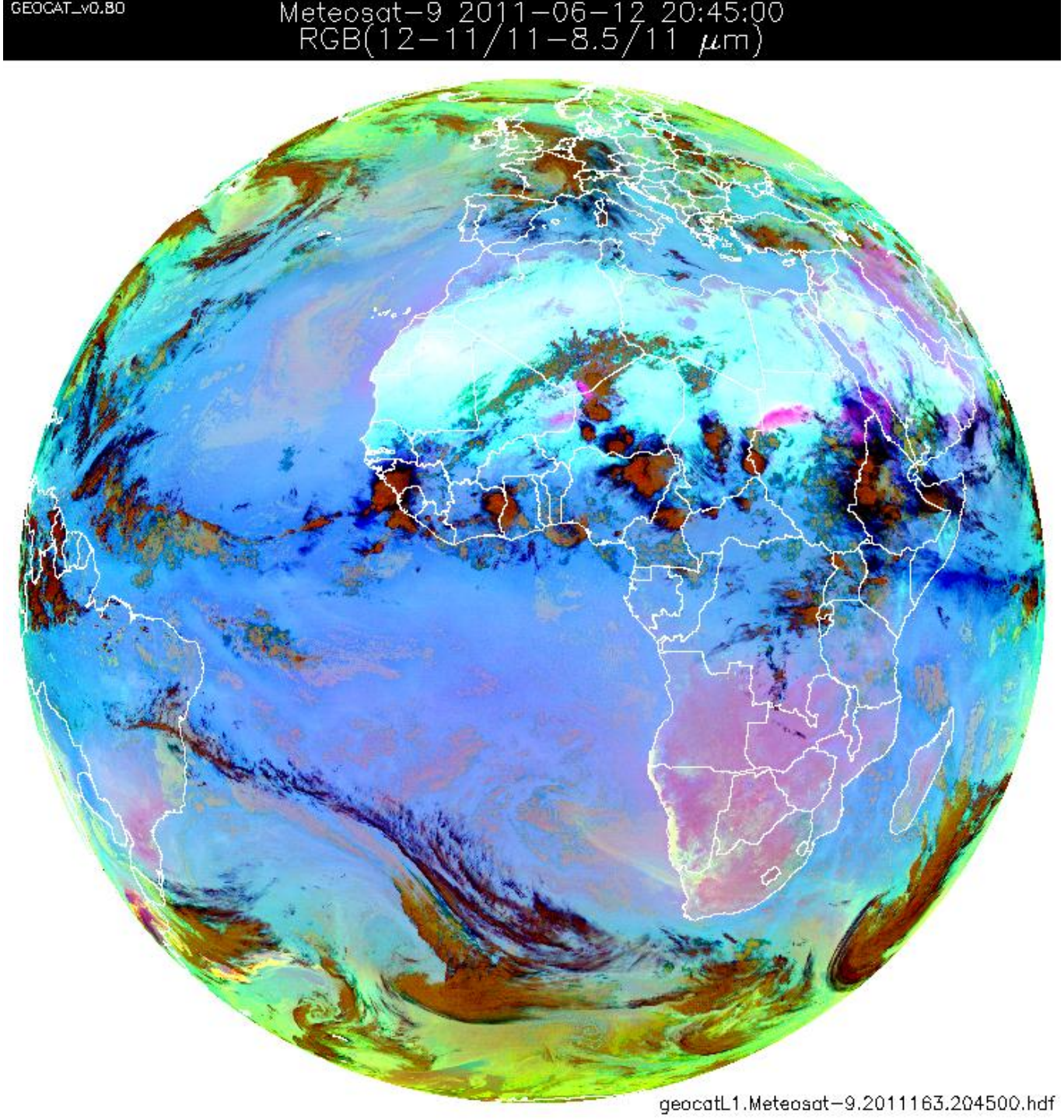
GOES-R Volcanic Cloud Products

- Infrared radiances are used to retrieve ash cloud height, mass loading, and effective particle radius (ash cloud height and mass loading are required GOES-R products)

- The ash cloud property products are primarily validated using lidar and are well within the accuracy specification

- An automated volcanic cloud alert system and an SO_2 product are also being developed for GOES-R

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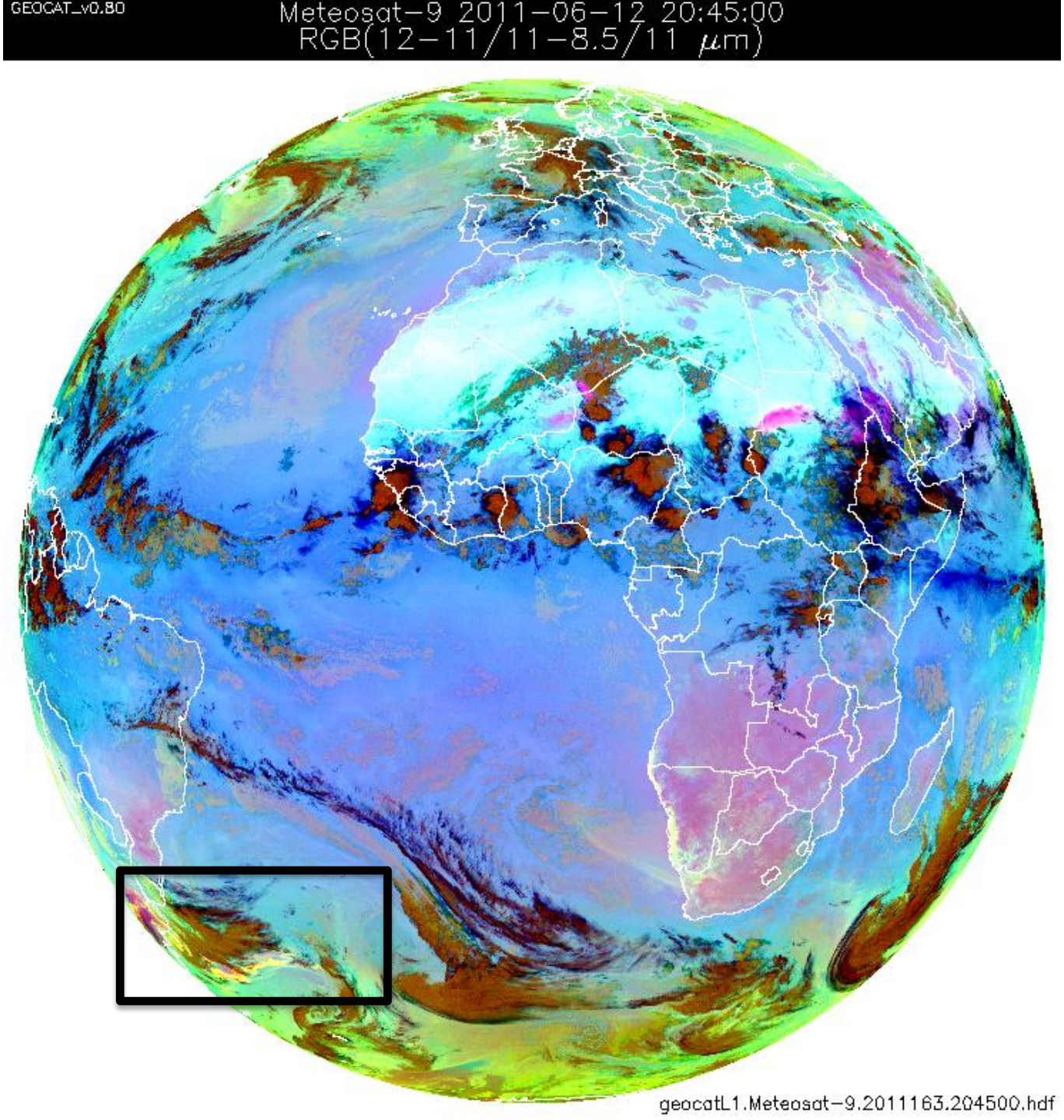
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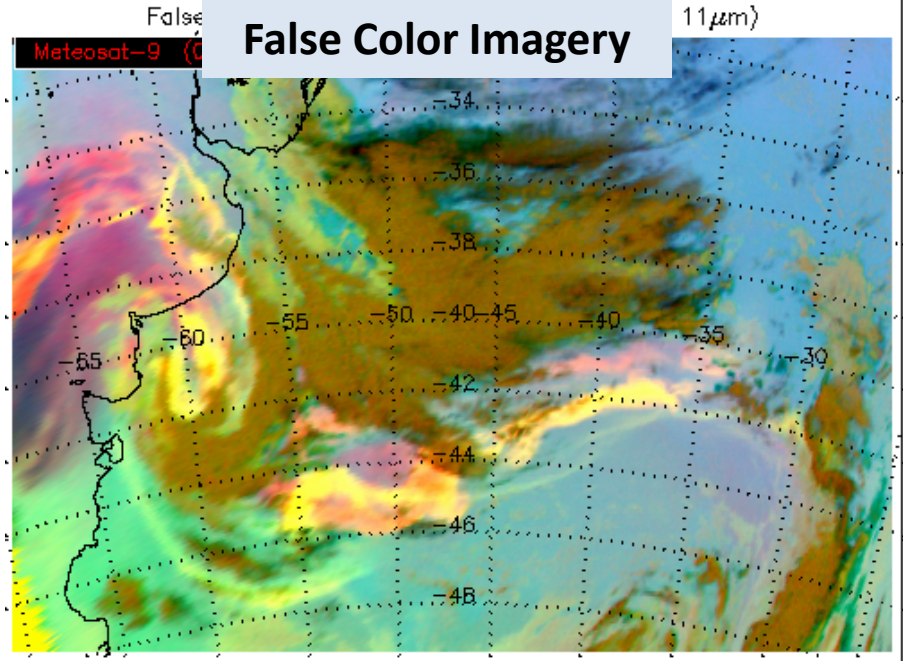
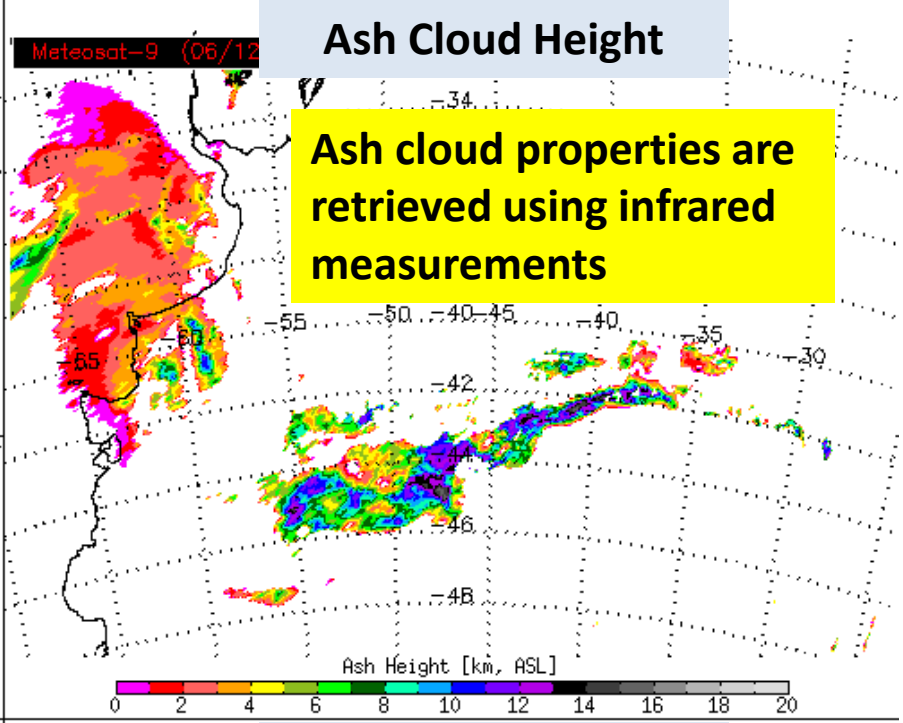
False Color Imagery

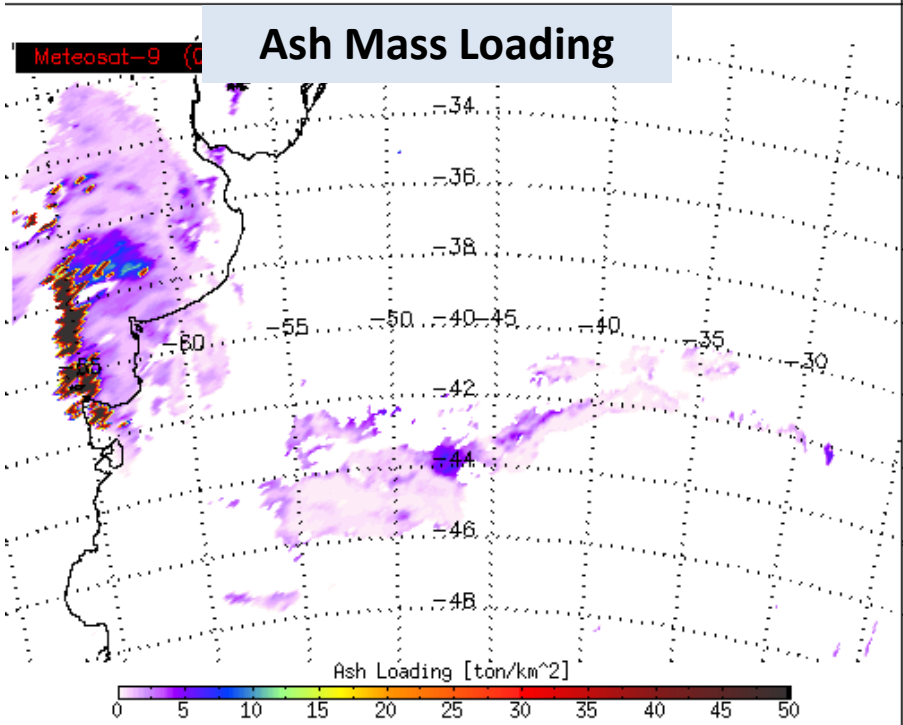


Ash Cloud Height

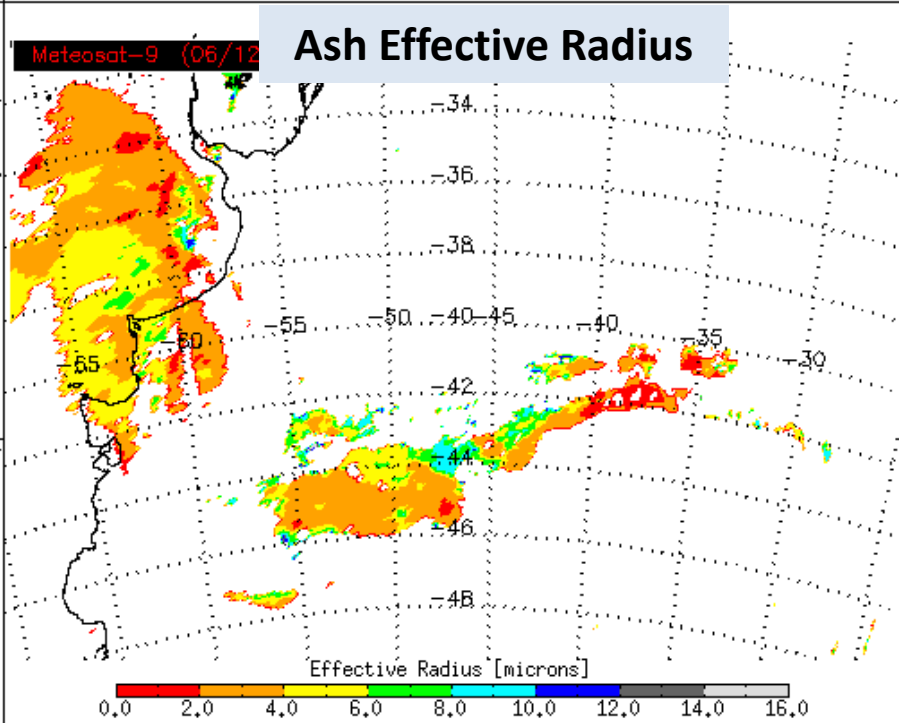
Ash cloud properties are retrieved using infrared measurements

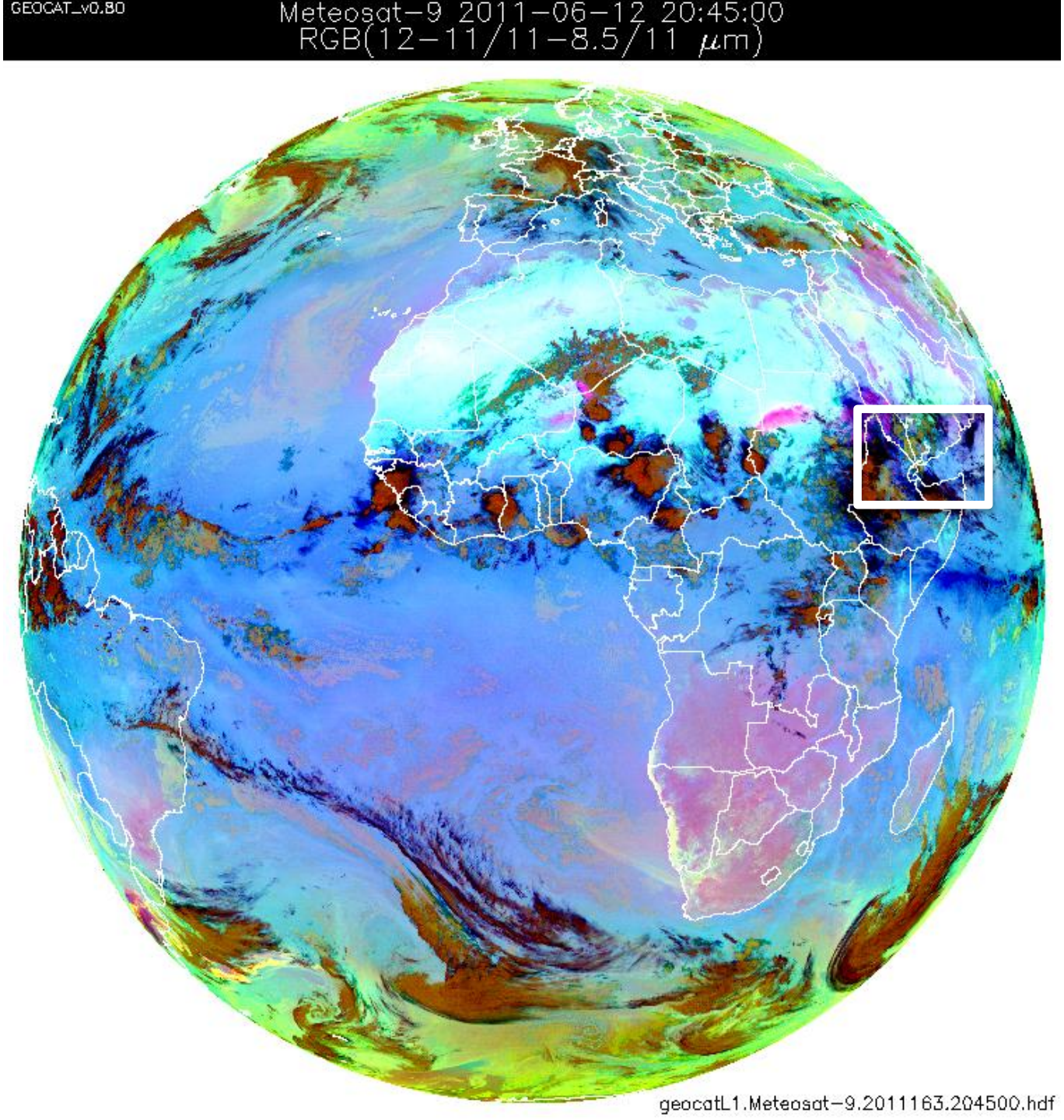


Ash Mass Loading



Ash Effective Radius

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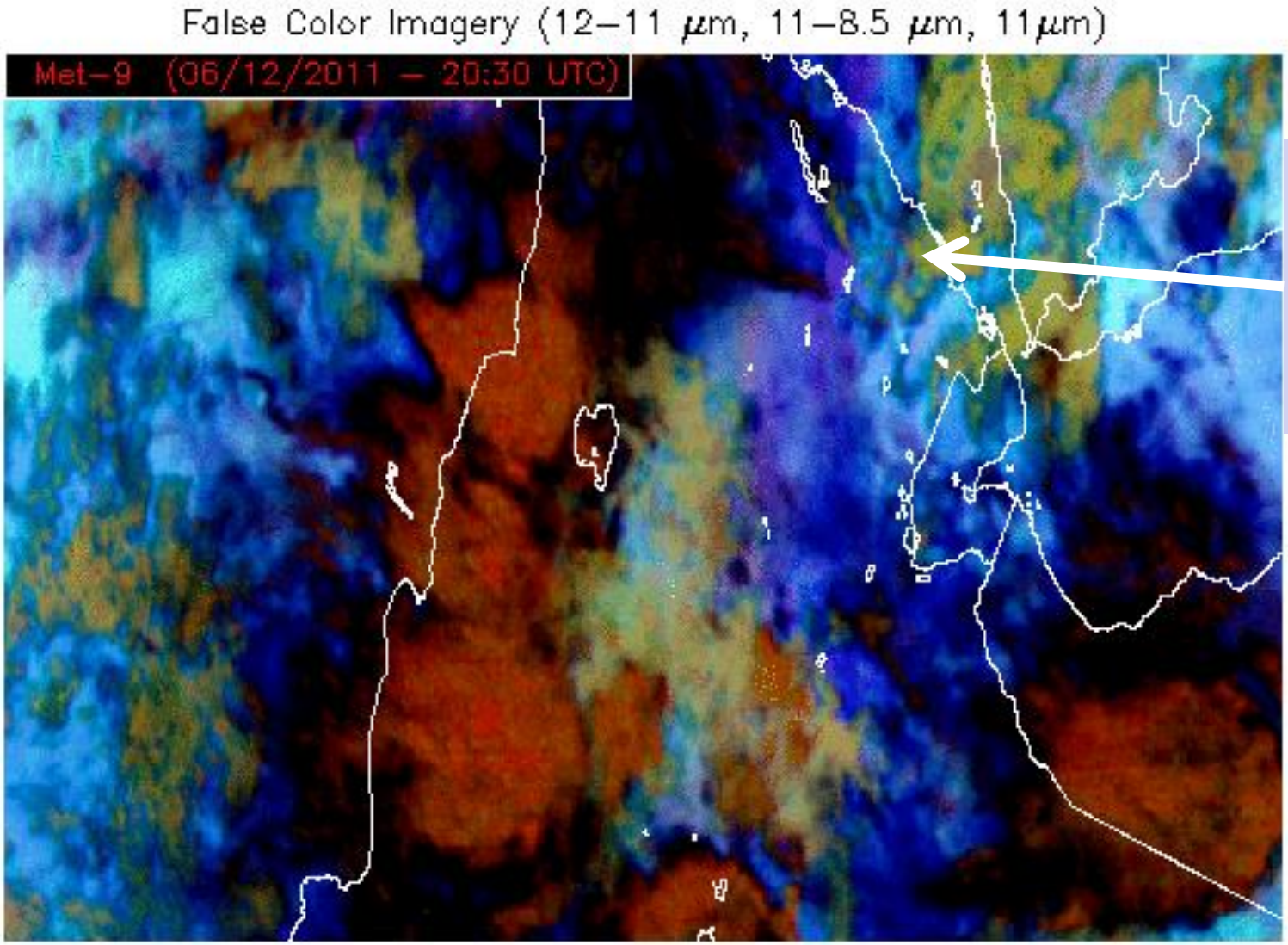
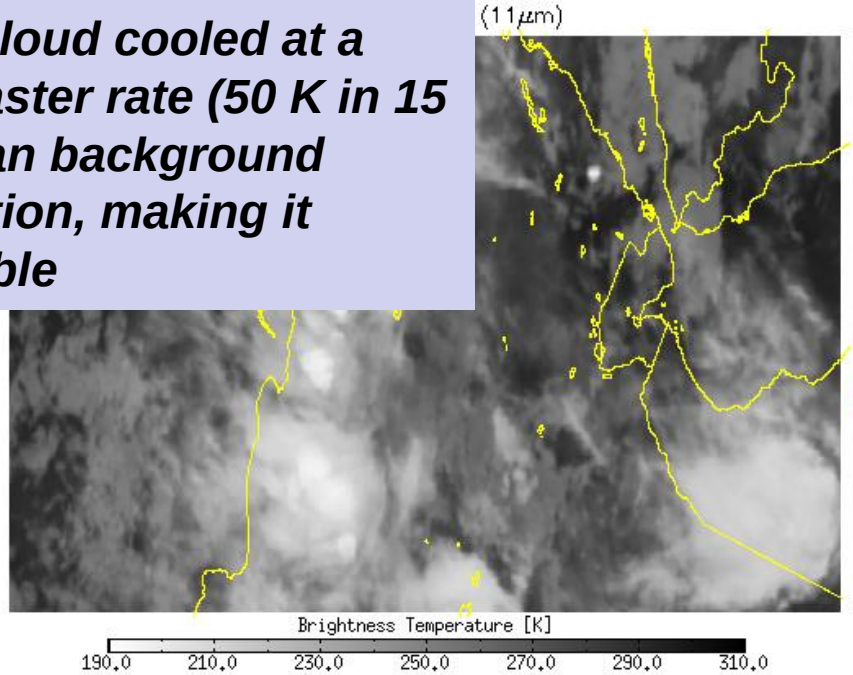
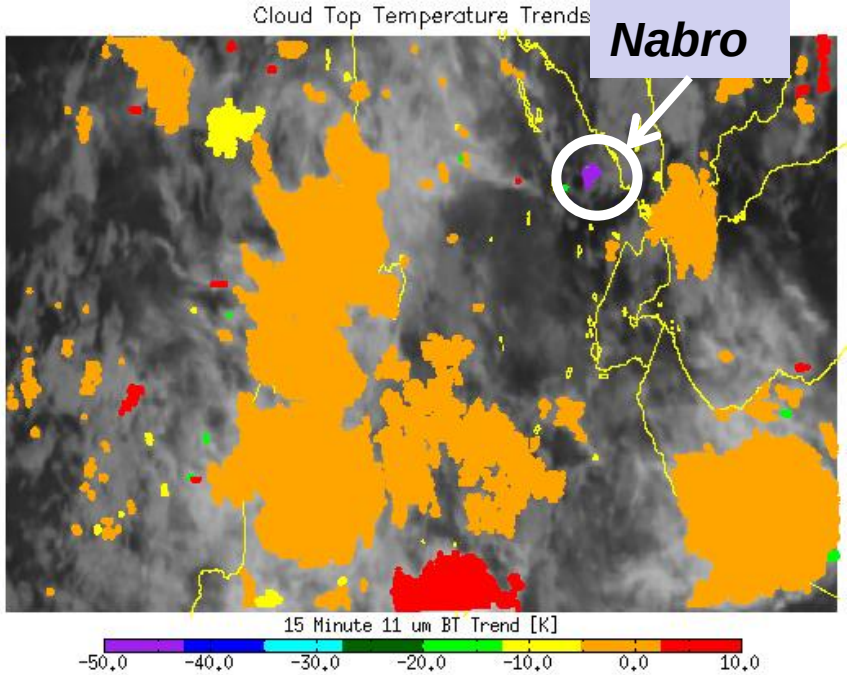
Eastern Africa - June 12, 2011 (20:30 – 23:45 UTC)



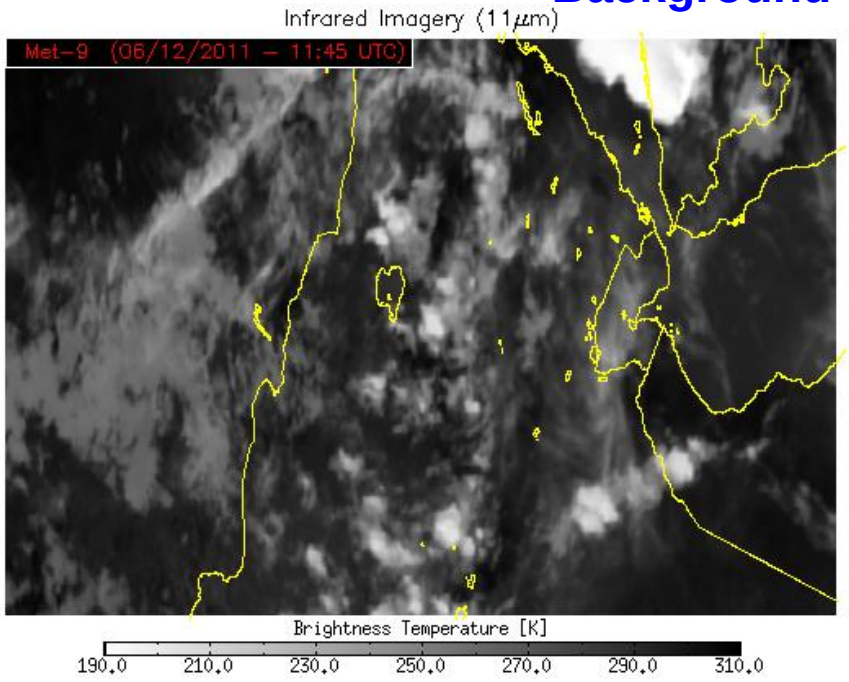
Nabro Erupts for the first time in observed history!

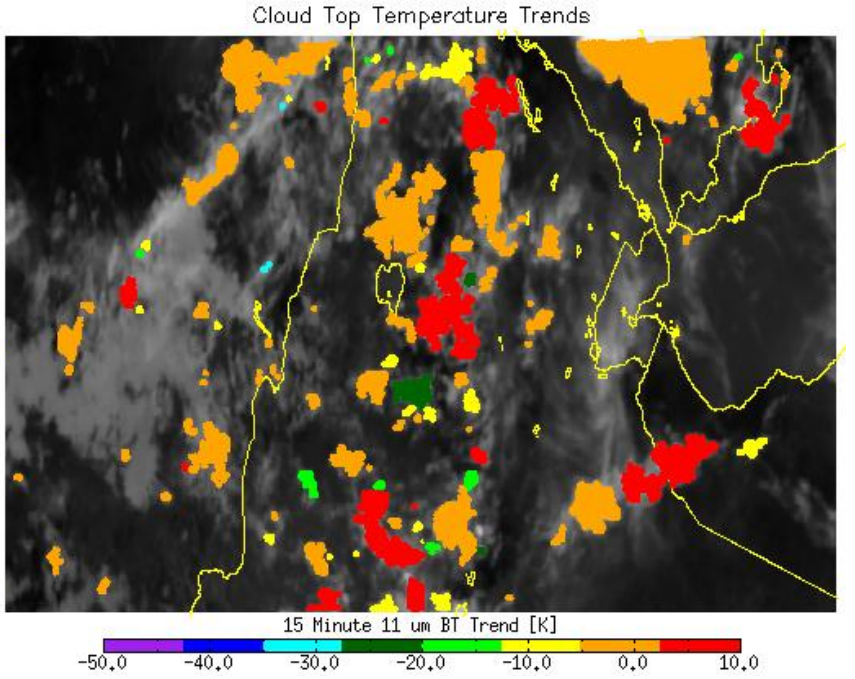
Nabro cloud cooled at a much faster rate (50 K in 15 min) than background convection, making it detectable

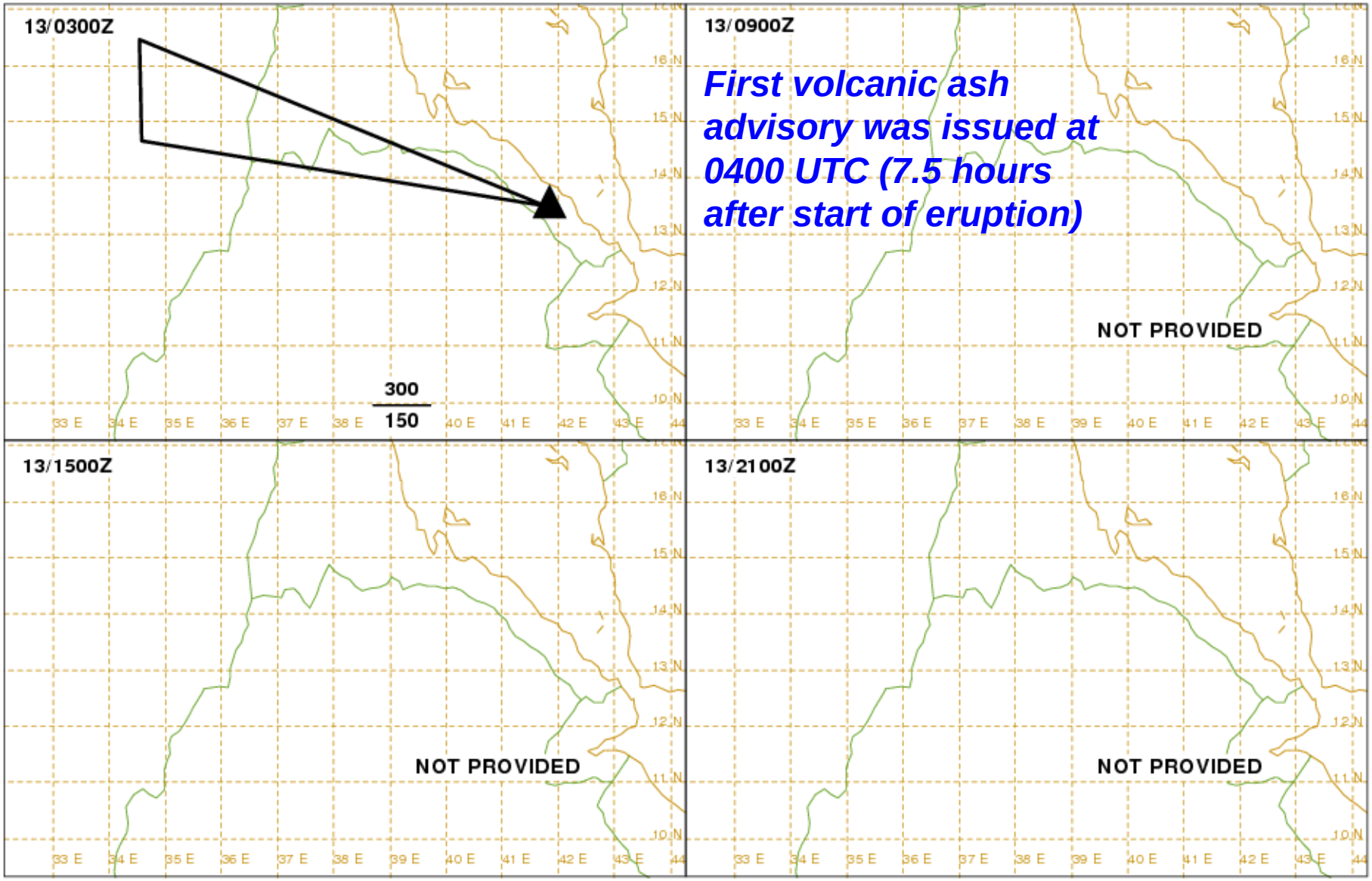




Background Convection







VOLCANIC ASH ADVISORY

DTG: 20110613/0400Z

VAAC: TOULOUSE

VOLCANO: DUBBI 0201-10

AREA: ETHIOPIA

SUMMIT ELEV: 1625M

METEO FRANCE

ADVISORY NR: 2011/01

INFO SOURCE: METEOSAT IMAGERY

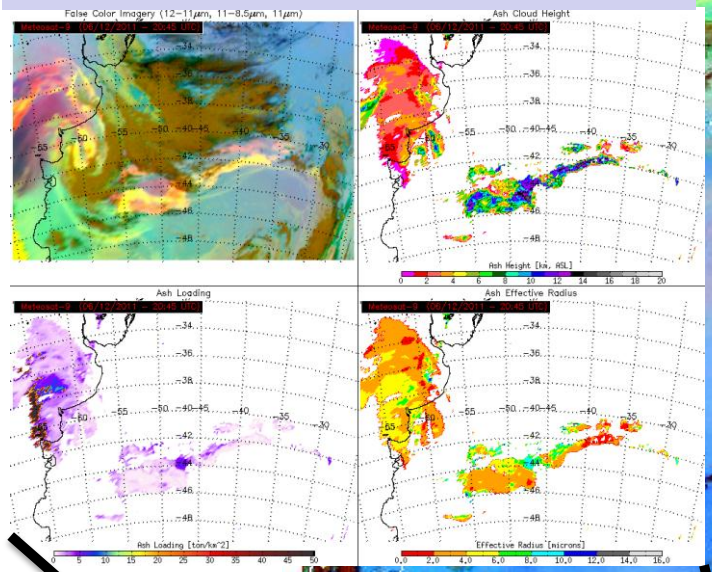
AVIATION COLOUR CODE: UNKNOWN

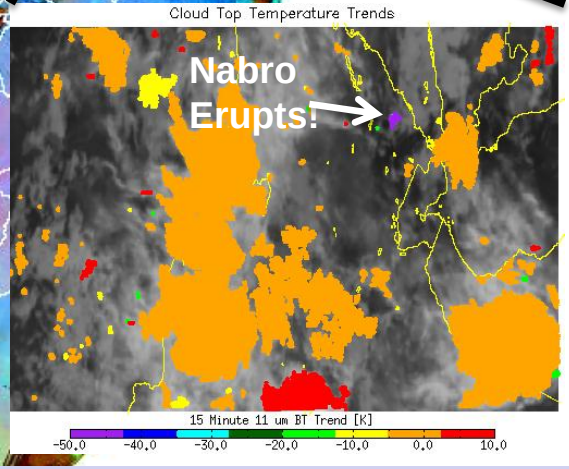
ERUPTION DETAILS: ERUPTION STARTED AROUND 23UTC

RMK: SEEMS NOW DECREASING

NXT ADVISORY: 20110613/1000Z

Automatically Track Properties of Cordon Caulle Volcanic Ash Cloud





Automatically Identify New Volcanic Eruptions and Alert Forecasters

Automated Alert Generated for Eruption of Cleveland on December 28, 2011

Text Alert

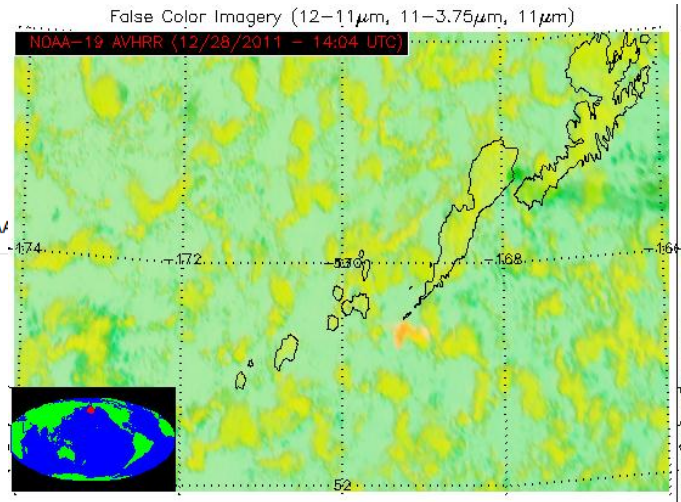
From: Mike Pavolonis <mpav@ssec.wisc.edu>
Subject: **VOLCANIC CLOUD ALERT**
Date: December 29, 2011 8:34:03 AM CST
To: Mike Pavolonis <mpav@ssec.wisc.edu>, Justin Sieglaff, NOAA/

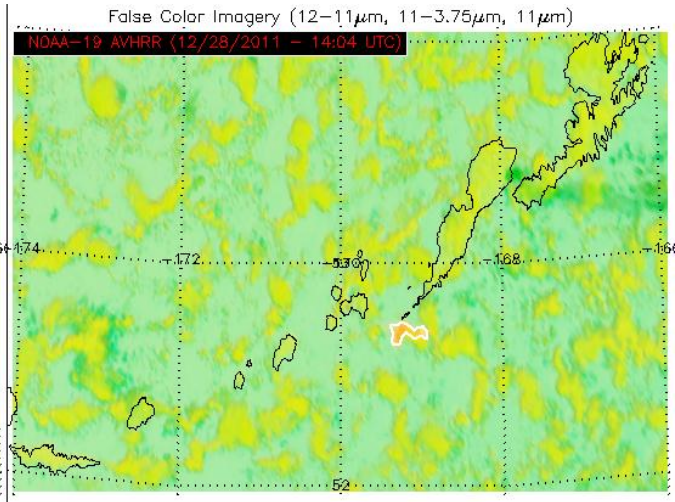
@**********GENERATING VOLCANIC CLOUD WARNINGS**********
DATE: 12/29/2011
TIME: 14:04 UTC
SATELLITE: NOAA-19 AVHRR
L1B FILENAME: NSS.HRPT.NP.D11363.S1404.E1418.B1489494.GC
ORBIT NUMBER: 1489494
NUMBER OF ASH CLOUD WARNINGS: 1
NUMBER OF VOLCANIC Cb WARNINGS: 0
NUMBER OF VOLCANIC HOT SPOT WARNINGS: 0

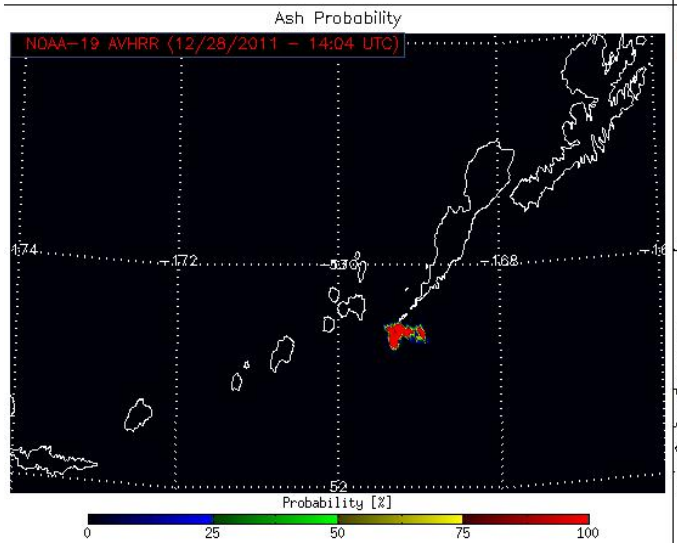
****

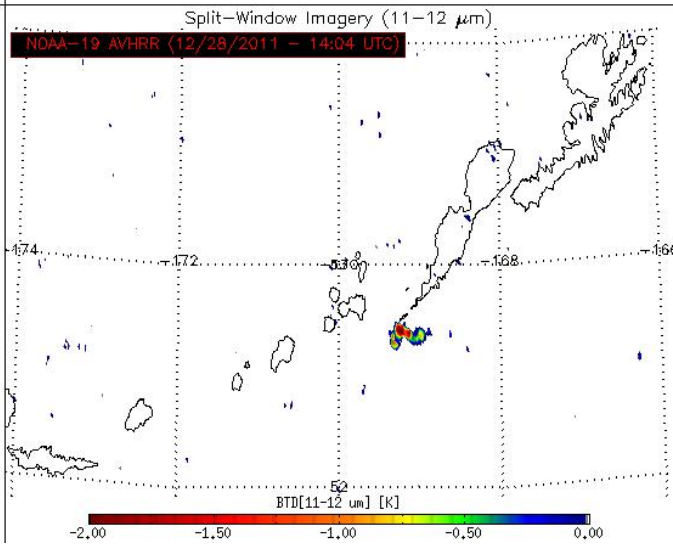
VOLCANIC ASH CLOUD FOUND
Radiative Center (Lat, Lon): 52.681, -169.109
Mean Viewing Angle (degrees): 41.83
Mean Solar Zenith Angle (degrees): 135.49
Nearby Volcanoes:
Tana(47.54 km)
Kagamil(52.48 km)
Vsevidof(57.21 km)
Cleveland(58.51 km)
Uliaga(61.66 km)
False Alarm Potential: 0 out of 276994
Maximum Height: 3.5 km (11567.35 ft)
Mean Tropopause Height: 8.5 km (27831.94 ft)
Median Effective Radius: 5.06 micron
Total Mass: 0.84 ktons
Total Mass of Fine Ash: 0.00 ktons
Total Area: 173.00 km^2
****

Ash Probability Images









These alerts are currently being distributed to the USGS in Alaska and will soon be distributed to the Anchorage VAAC and Air Force Weather Agency

GOES-R Fog/Low Cloud Products

GOES-R Fog/Low Cloud Products

- **Satellite data (from several channels) and NWP model fields from the RUC (the GFS is used outside of RUC domain) are used as predictors into a Naïve Bayes model**

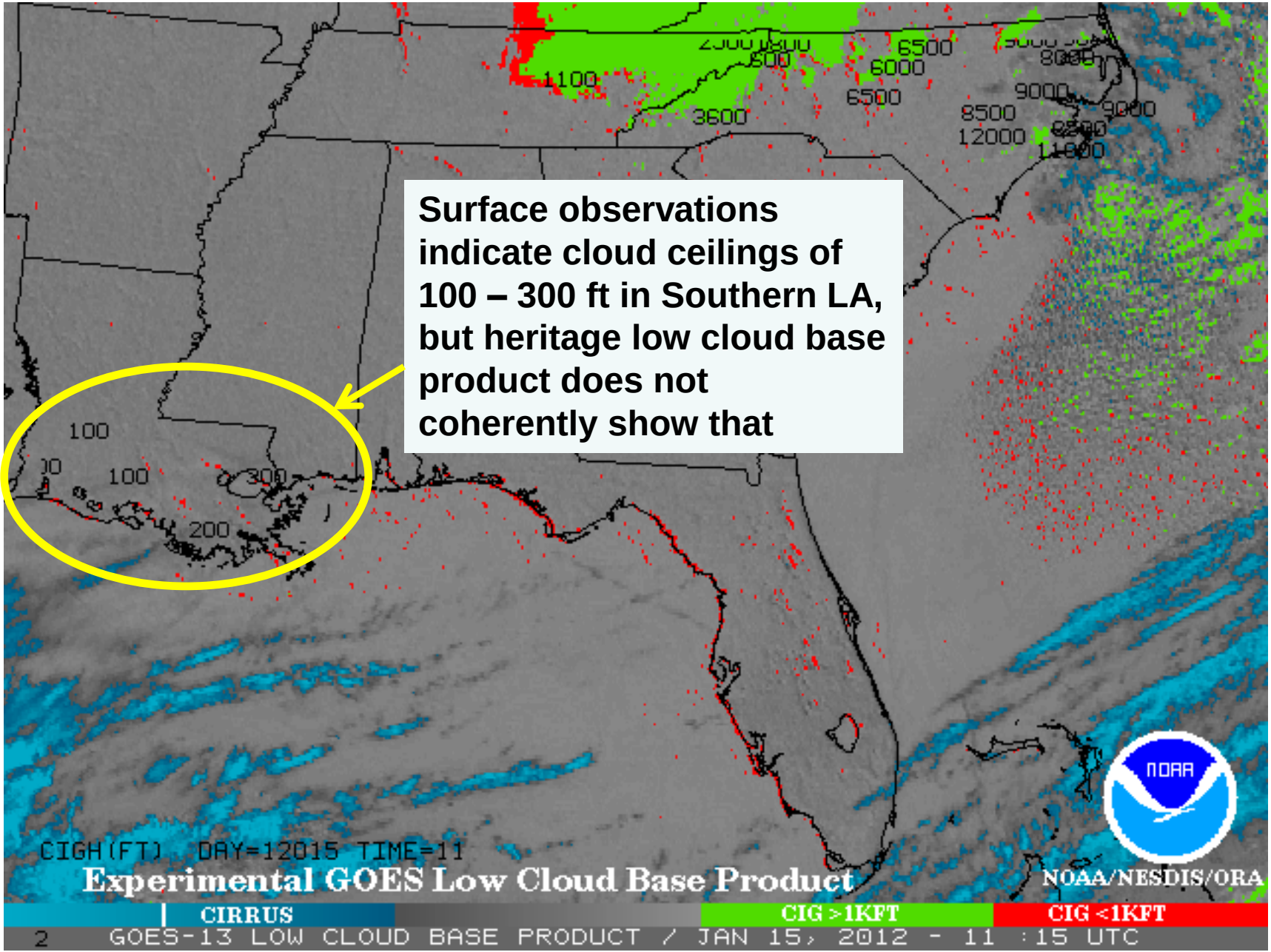
- **Surface observations are used to train the Naïve Bayes classifier**

- **Products produced: probability of MVFR ceilings, probability of IFR ceilings, probability of LIFR ceilings, fog depth, cloud phase**

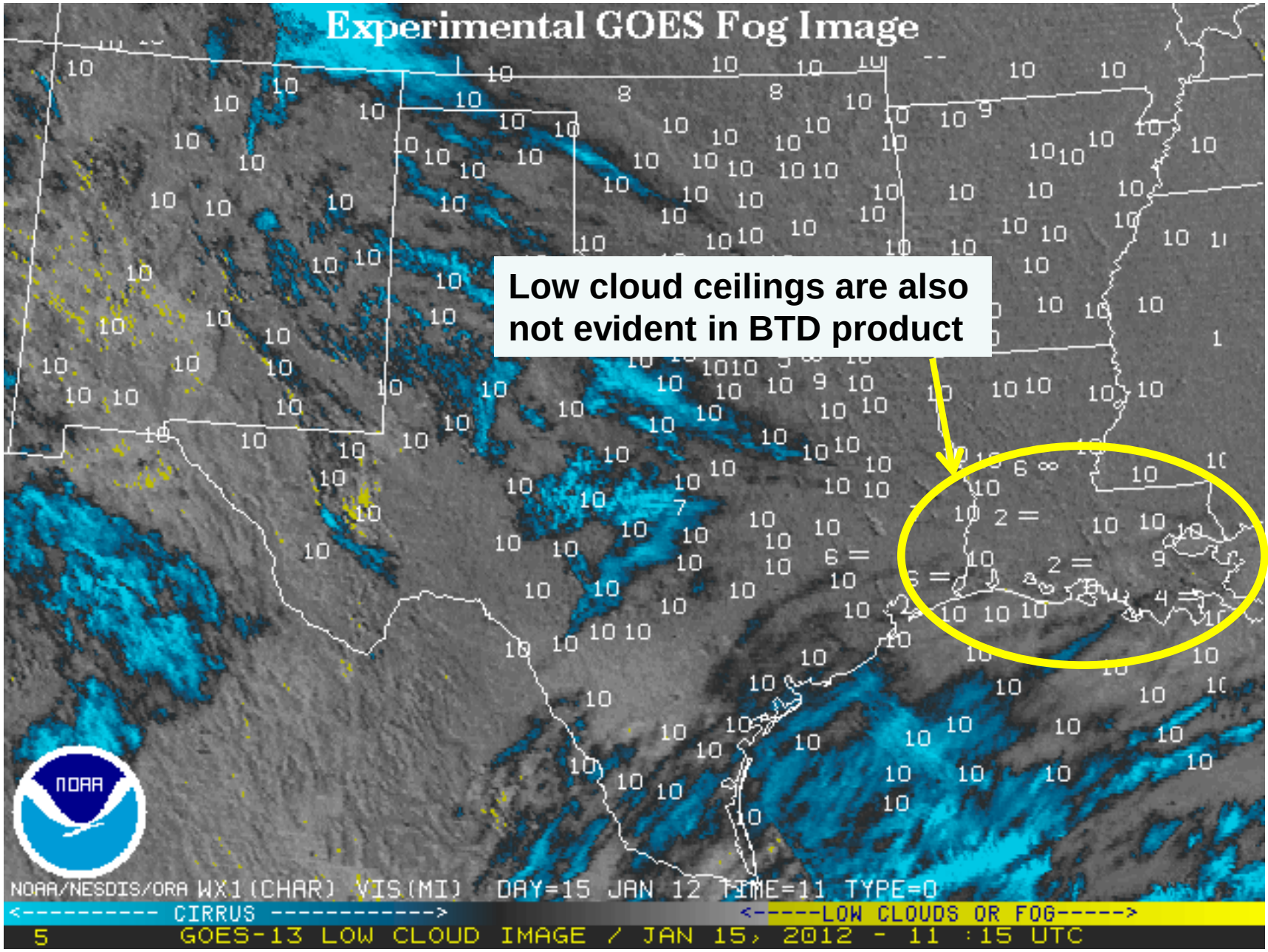
- **Products are currently being distributed to NWS Alaska Region, MKX WFO, and AWC via Proving Ground**

- **VFR - Visual flight rules**
  ceiling > 3000 ft (914 m)
- **MVFR - Marginal visual flight rules**
  1000 ft (305 m) < ceiling < 3000 ft (914 m)
- ***IFR - Instrument flight rules***
  500 ft (152 m) < ceiling < 1000 ft (305 m)
- ***LIFR - Low instrument flight rules***
  ceiling < 500 ft (152 m)

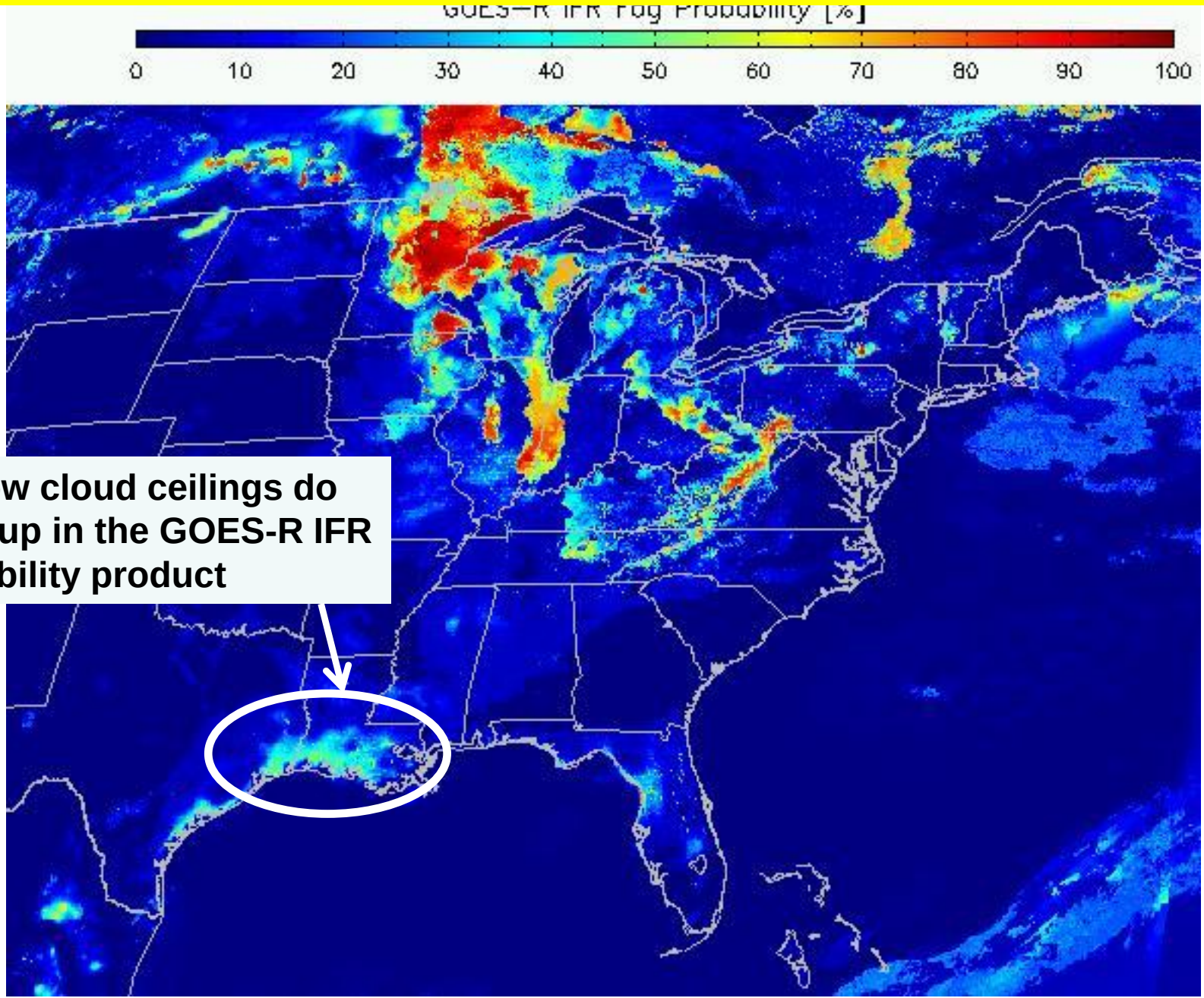
Southern LA - (January 15, 2012, 11:15 UTC)



Southern LA - (January 15, 2012, 11:15 UTC)

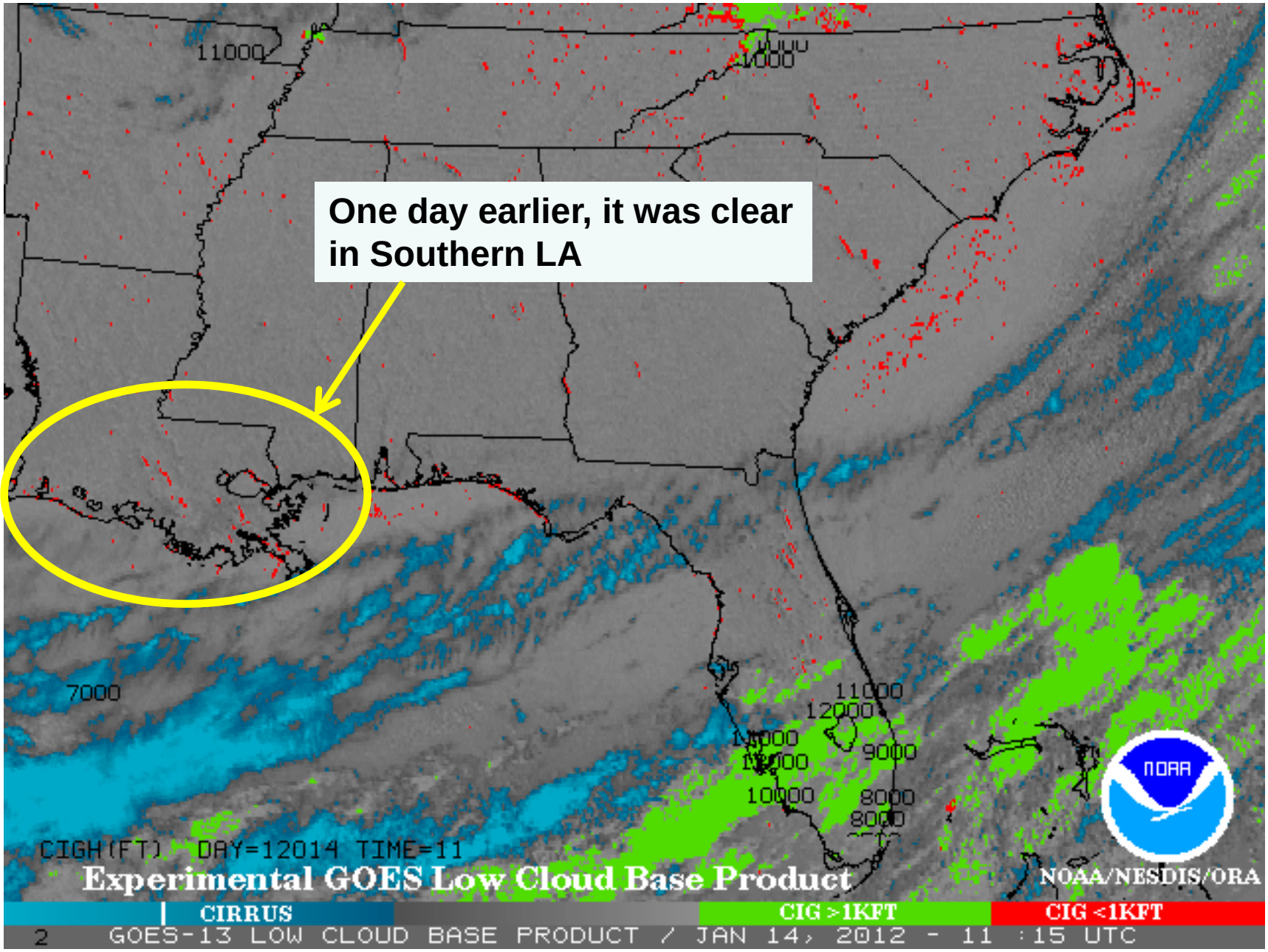


Southern LA - (January 15, 2012, 11:15 UTC)

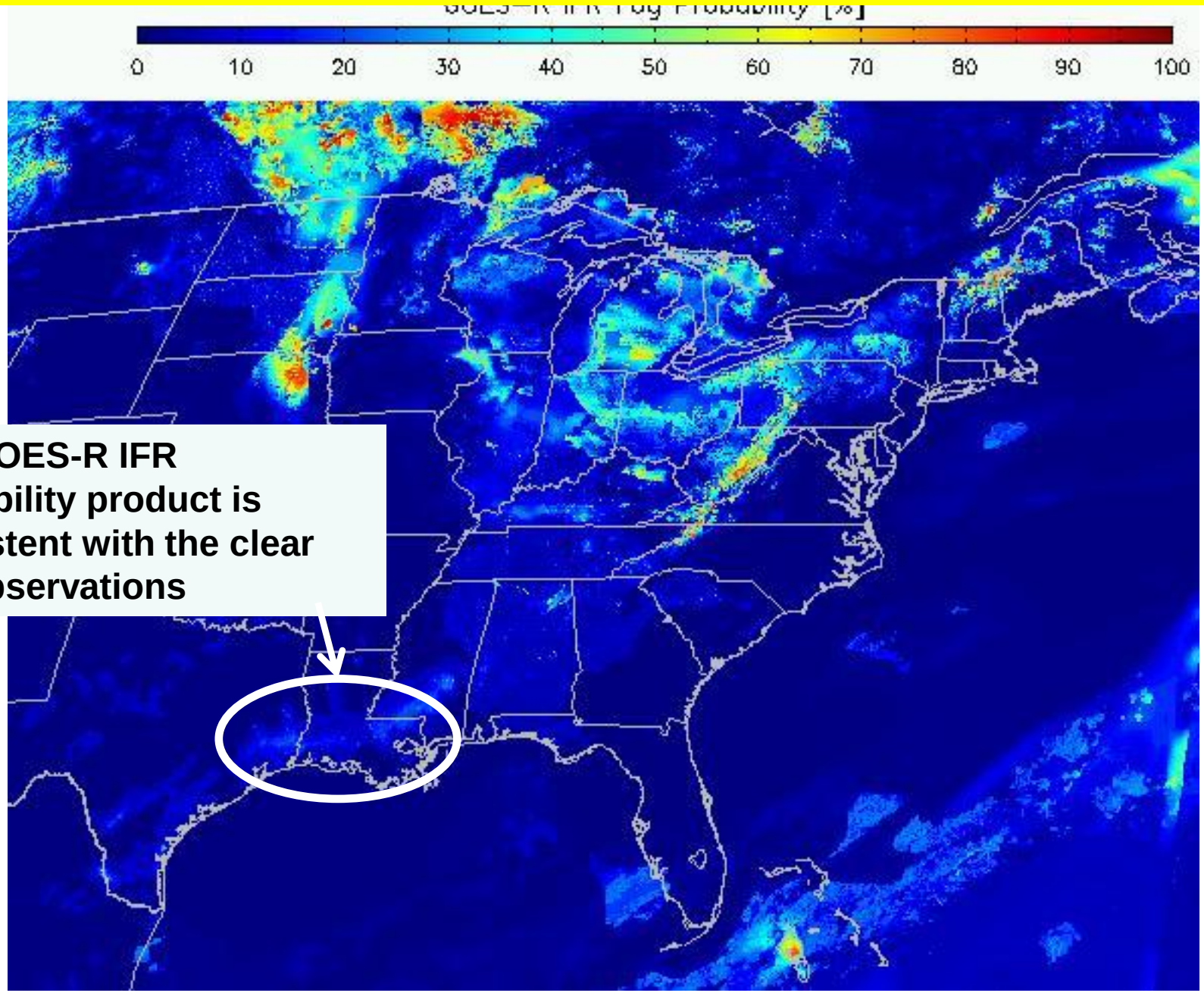


The low cloud ceilings do show up in the GOES-R IFR probability product

Southern LA - (January 14, 2012, 11:15 UTC)

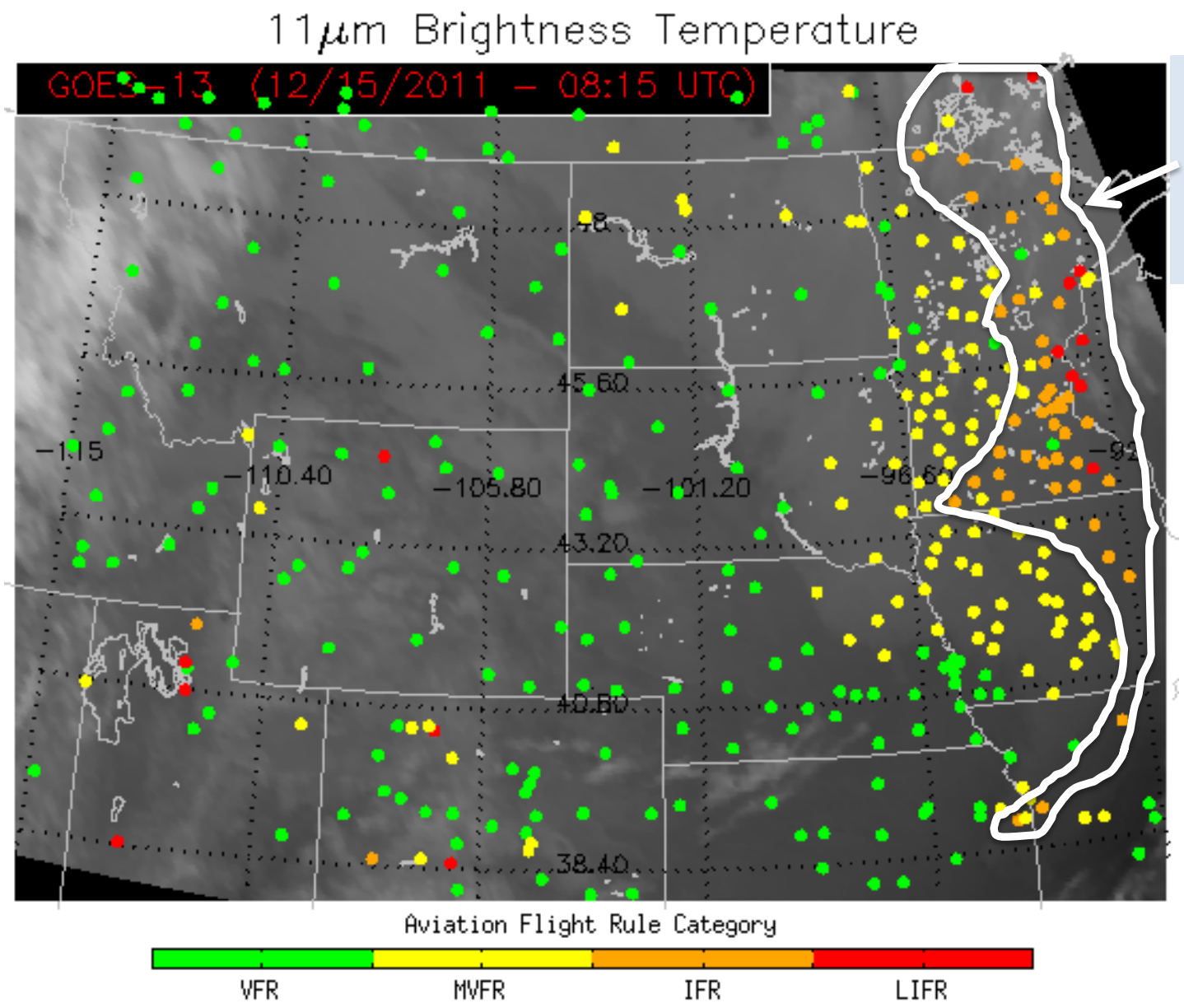


Southern LA - (January 14, 2012, 11:15 UTC)



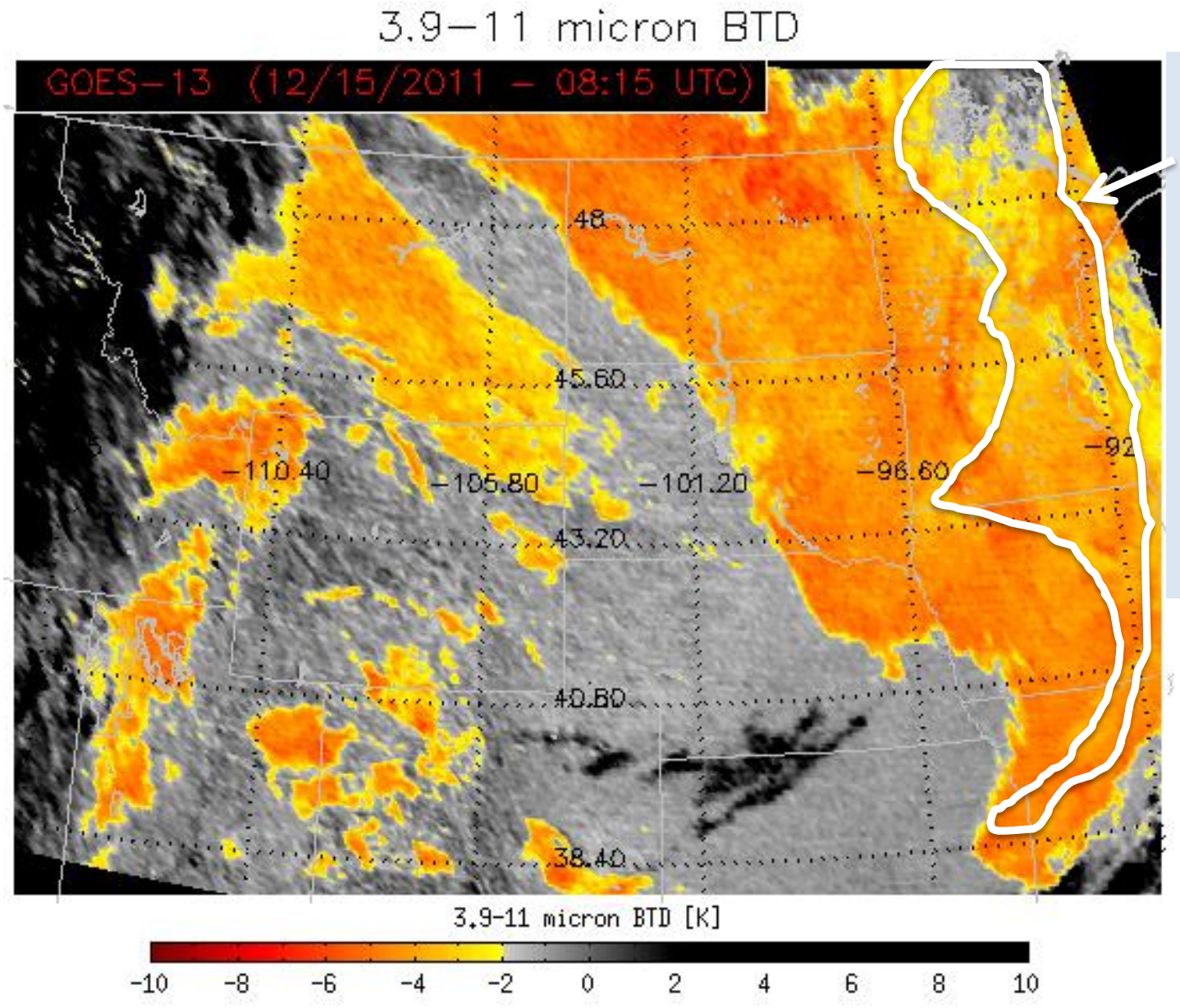
The GOES-R IFR probability product is consistent with the clear sky observations

Upper Midwest (December 15, 2011 – 08:15 UTC)



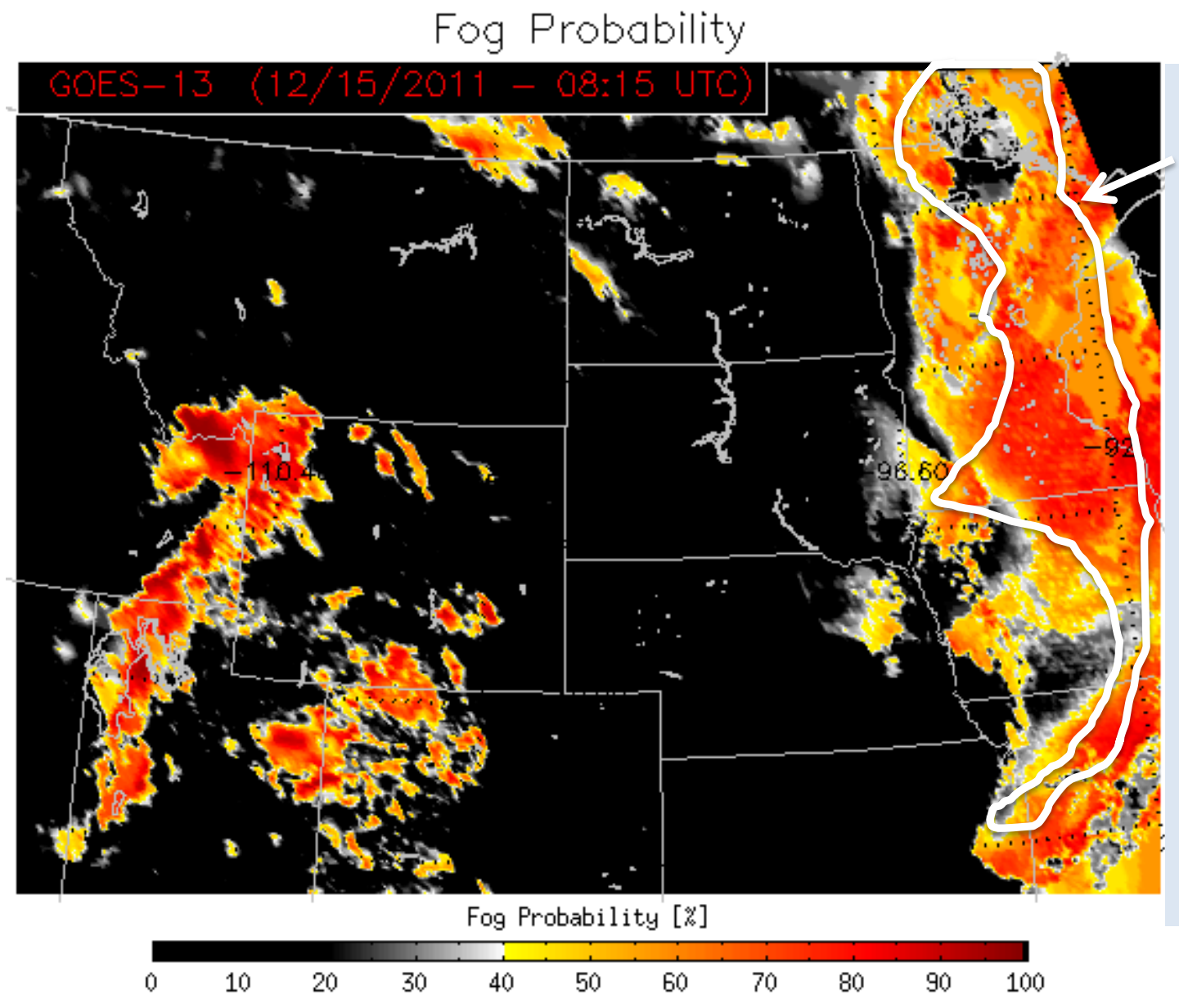
Only the eastern edge of cloud deck is producing IFR or LIFR conditions

Upper Midwest (December 15, 2011 – 08:15 UTC)



Traditional nighttime BTD "fog" product highlights a very large area, most of which does *NOT* have low cloud ceilings that would significantly impact aviation or ground transportation

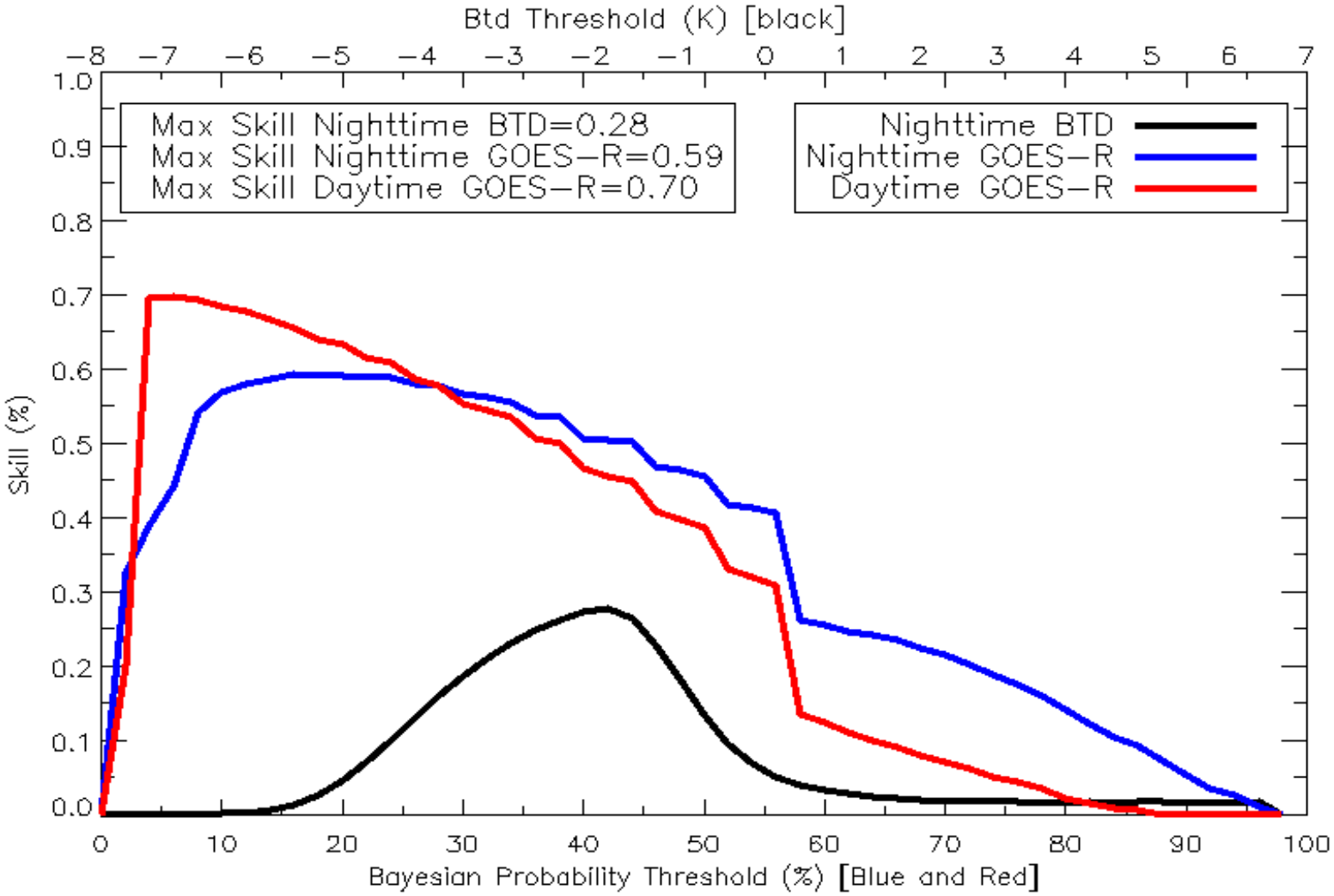
Upper Midwest (December 15, 2011 – 08:15 UTC)



- The GOES-R IFR probability product highlights the hazard area with much more accuracy than traditional product
- We are experimenting with adopting a color bar commonly used to display the BTD product in order to give the GOES-R product a familiar look

Validating the Identification of IFR Ceilings

- **Comparison to surface observations of cloud ceiling indicate that the GOES-R product has a maximum skill score of 0.59 (at night) and 0.70 (during the day)**
- **The traditional BTD approach has a maximum skill score of only 0.28 (at night)**



Summary

- **Algorithms to detect and quantitatively characterize volcanic cloud and low cloud ceiling hazards have been developed in preparation for GOES-R**

- **These algorithms have been shown to improve upon heritage approaches**
- ***Near-term plans:***
  - ***Volcanic clouds:*** **multi-sensor volcanic cloud alert and retrieval system will continue to be developed, validated, and tested in operations**

  - ***Fog/low clouds:*** **Start using expanded domain Rapid Refresh model, update user training module, and incorporate morphometric characterization of landforms into classifier**